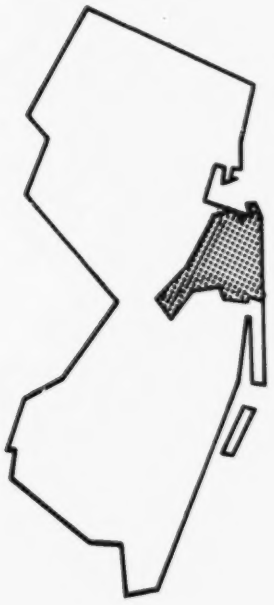
FEM 1.209: 340298

COMPLETED

FLOOD INSURANCE STUDY

ORIGINAL

TOWNSHIP OF HAZLET, NEW JERSEY
MONMOUTH COUNTY



JUNE 1, 1982

Federal Emergency Management Agency

COMMUNITY NUMBER - 340298

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index

Flood Insurance Rate Map

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Hazlet, Monmouth County, New Jersey, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert Hazlet to the regular program of flood insurance by the Federal Emergency Management Agency (FEMA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally-supported studies are based. These criteria take precedence over the minimum federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3. In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses in this study represent a revision of the original analyses completed in September 1977 by Tetra Tech, Inc., for the Federal Emergency Management Agency, under Contract No. H-3830. The updated version was prepared by Dewberry & Davis under agreement with the FEMA. The updated version was completed in October 1981.

1.3 Coordination

On August 26, 1976, the existence and severity of flooding in Hazlet were discussed at an initial Consultation and Coordination Officer's (CCO) meeting attended by representatives of the FEMA, the Township of Hazlet, and Tetra Tech, Inc. (the study contractor). Numerous agencies and officials were contacted in an attempt to explore all possible sources of data. Information describing hydrologic conditions, drainage patterns and other flood-related data, as well as information on the topography and demography of Hazlet was sought from the Hazlet Chamber of Commerce,

the Hazlet Department of Public Works, the Hazlet Sewerage Authority, the Monmouth County Planning Board, the National Oceanic and Atmospheric Administration (NOAA), the New Jersey Department of Environmental Protection, the New Jersey Geological Survey, the Soil Conservation Service (SCS), the New Jersey Department of Conservation and Economic Development, the New York Distict of the U. S. Army Corps of Engineers (COE), and the U. S. Geological Survey (USGS). On January 7, 1982, the results of the study were reviewed at a final CCO meeting held with representatives of the FEMA, the township, and Dewberry & Davis.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Hazlet, Monmouth County, New Jersey. The area of study is shown on the Vicinity Map (Figure 1).

The entire lengths of Waackaack Creek, Flat Creek, and Monascunk Creek within the corporate limits, and East Creek from the downstream corporate limits to approximately 1,550 feet upstream of Middle Road were studied by detailed methods. Tidal flooding from Raritan Bay affects portions of Waackaack Creek, Flat Creek, East Creek and Chingarora Creek within Hazlet. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction for the next five years, through October 1986.

The remaining portion of East Creek was studied by approximate methods. Portions of Thornes Creek, Natco Lake, and Lupatatong Creek were studied by approximate methods and are affected by tidal flooding. Approximate methods of analysis were used to study those areas having low development potential and minimal flood hazards as identified at the initiation of the study. The scope and methods of study were proposed to and agreed upon by the FEMA.

2.2 Community Description

The Township of Hazlet is located in the northwestern portion of Monmouth County in eastern New Jersey, approximately 20 miles southeast of the Newark, 35 miles northeast of Trenton, and 75 miles northwest of Atlantic City. Hazlet is bordered by the Boroughs of Keyport and Union Beach to the north, the Townships of Middletown and Keansburg to the east, the Township of Holmdel to the south, and the Township of Aberdeen to the west.

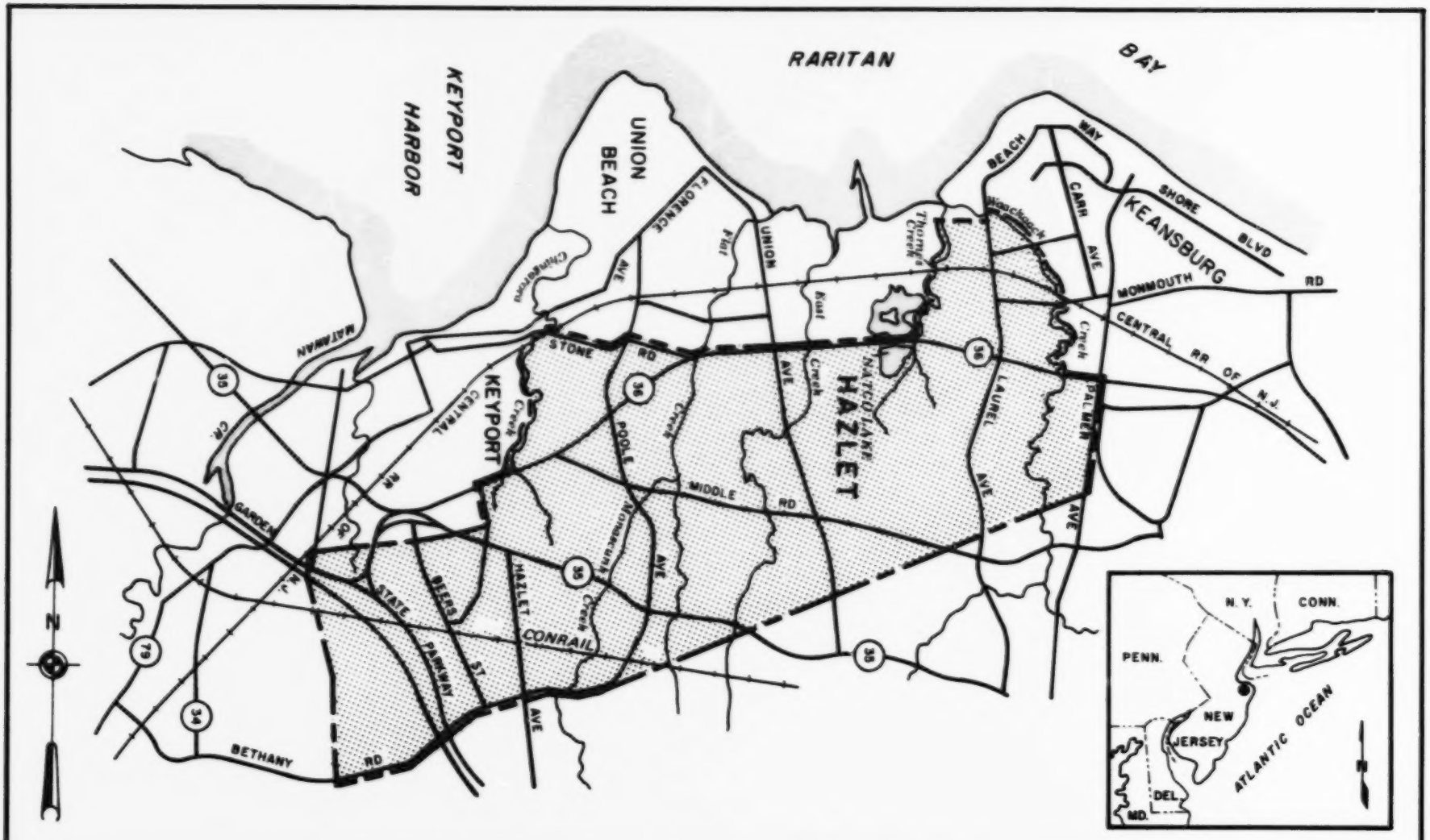

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HAZLET, NJ
(MONMOUTH CO.)

APPROXIMATE SCALE
0 4000 8000 12000 16000 FEET

VICINITY MAP

BEST DOCUMENT AVAILABLE

Hazlet covers an area of approximately 5.6 square miles. It has become primarily a densely populated residential community, although numerous commercial establishments are also located in the township. The population of the township increased from 1,583 in 1910 to 22,239 in 1970 (Reference 1). This represents a growth of 1,300 percent over the 60-year period. By 1980, the population of Hazlet increased to 23,013, a 3-percent increase over 1970 (Reference 2). The Monmouth County Planning Board projects an increase in population to 28,500 by the year 2000.

On September 3, 1609, Henry Hudson and his crew landed on the shore of present-day Keyport. In 1664, migrant New Englanders settled along the Raritan Bay shore area. Nineteen years later, the Proprietary Assembly formed Monmouth County, named in honor of Monmouthshire, England. On February 25, 1848, the New Jersey State Legislature formed the Township of Raritan, which consisted of a large stretch of land, including the study area, in northwestern Monmouth County. Since that date, several communities separated from the township at various times. On November 28, 1967, the remaining area of the Township of Raritan changed its name to the Township of Hazlet.

Hazlet has a temperate climate, with warm summers and moderate winters. The annual temperature averages approximately 53 degrees Fahrenheit (°F), with January usually the coldest month (mean temperature 32°F) and July usually the warmest month (mean temperature 74°F). Summer temperatures rarely exceed 100°F, and winter temperatures seldom fall below 0°F. the average frost-free period lasts almost 200 days per year. Precipitation averages approximately 45 inches annually, with July and August being the wettest months. Snowfall, which can occur from October through May, averages almost 25 inches annually.

Vegetation in the township varies from species preferring the wetlands along the creeks to those more suitable to the drier, inland areas. The marshes along the creeks are the habitat for several species of grasses and woody shrubs, including plume grass, saltmarsh cord grass, salt meadow grass, spike grass, salt worts, high-tide bush, and sea lavender.

The trees which thrive on the wet soil of the flood plain and marshes include the black willow, blackgum, sweet gum, and red maple. The drier inland regions provide a suitable habitat for such trees as maple, oak, locust, wild cherry, mulberry, and birch.

Geologically, Hazlet is a part of the Atlantic Coastal Plain, which is composed primarily of sands, silts, gravel, and clays. This plain formed as a result of sedimentation from the eroding Appalachian Mountains and now varies in thickness within Monmouth County from approximately 500 feet in the northwest to almost 1,200 feet in the southeast. The township is underlain by sediments associated with the Merchantville and Woodbury formations, which date back to the Cretaceous period.

The north-central and northeast portions of Hazlet lie in a low coastal plain. The topography of the region is characterized by wide, flat expanses of land accompanied by large areas of marshes. The terrain ranges in elevation from near sea level in the extreme northeast to approximately 20 feet 0.5 mile south of State Route 36. South of this flood plain, the land rises steeply to a maximum elevation of approximately 100 feet.

Hazlet is drained by numerous creeks. Originating in the Mount Pleasant Hills, these creeks flow north and envelop wide marshes as they traverse the study area.

Waackaack Creek forms the northeastern boundary of the township, Chingarora Creek comprises the northwest boundary, and Luppatatong Creek flows near the southwest boundary. Between these waterways, the terrain is divided by Thornes Creek, East Creek, Flat Creek, and Monascunk Creek.

2.3 Principal Flood Problems

The Township of Hazlet is subject to floods resulting from tropical storms, extratropical cyclones, and, to a lesser extent, severe thunderstorms. Tropical hurricanes occur during late summer and autumn and can result in severe damage to coastal regions. Extratropical cyclones, commonly referred to as northeasters, can develop at almost any time of year. These storms are characterized by a general rainfall over entire drainage basins, causing fluvial flooding. Thunderstorms are a common occurrence during the summer months.

There are no reports of previous specific flooding in this community. However, reports from both the COE and the New Jersey Department of Environmental Protection indicate that numerous storms have affected the coastline of Monmouth County (References 3, 4, 5, and 6). Records of storms prior to 1900 are very brief and inconsistent. Since 1944, six major storms have produced extremely high tidal waters in the vicinity of the study area.

Hazlet was struck by hurricane-force winds on September 14-15, 1944. These strong winds and high waves resulted in a maximum tidal elevation of 7.4 feet at both Sandy Hook and Perth Amboy, New Jersey, and a high-water mark of 8.4 feet at Keansburg, New Jersey. Floodwaters, which extended about 2,000 feet inland, damaged homes along the beachfront. The entire boardwalk along with the steamboat pier was destroyed by high tides and strong waves.

On November 25, 1950, a major extratropical cyclone (northeaster) hit the study area. Stong gale-force winds accompanied by heavy rains produced extremely high tides in Sandy Hook Bay. During the passage of this storm, Sandy Hook recorded a maximum tidal elevation of 7.2 feet and a record tidal surge of 8.7 feet.

The study area was hit by a major northeaster on November 6-7, 1953, causing strong winds of near hurricane force. A tidal height of 7.9 feet was recorded at Sandy Hook.

On September 12, 1960, Hurricane Donna passed through the study area with wind gusts of nearly 70 miles per hour (mph). The concurrence of the hurricane tide surge with the mean high tide resulted in a record tide of 8.6 feet at Sandy Hook and a tide of 10 feet at Perth Amboy, which is located less than 15 miles northwest of Hazlet.

A northeaster struck the Monmouth County shoreline on March 6-8, 1962. This storm generated winds of 45 mph, with gusts up to 70 mph, and remained in the region for 60 hours. This unusually long duration coincided with five successive high spring tides. The combination of the tidal surge with the high astronomic tides produced a maximum tidal elevation of 7.8 feet at Sandy Hook. Severe flooding conditions along the entire coastline of New Jersey resulted.

Torrential rains and high winds caused by Hurricane Belle struck the New Jersey shoreline on August 9, 1976. Winds of 100 mph were reported along the coast, and heavy flooding occurred after a high tide in Ocean and Monmouth Counties. In Asbury Park, 2.56 inches of rain fell in a 24-hour period. At Beach Haven, tidal surge in combination with high tide levels caused a tidal height 6 feet above normal.

2.4 Flood Protection Measures

Hazlet is protected by the Raritan Bay and Sandy Hook Bay Beach Erosion and Hurricane Project (Reference 7). This levee, constructed by the COE, extends from Natco Lake in the Borough of Union Beach to the west bank of Pews Creek in the Township of Middletown. The FEMA specifies that all levees must have a minimum of 3 feet freeboard against 100-year flooding to be considered a safe flood protection structure. The levee has a nominal crest elevation of 15 feet and meets FEMA freeboard requirements for the 100-year flood. In addition, a 30-feet wide closure gate associated with this levee is located at the mouth of Waackaack Creek in the Borough of Keansburg. This gate is operated by the COE and is closed when the Raritan Bay tidal elevation reaches 4.5 feet (Reference 7). There are no other flood protection structures located on streams studied in this report.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or

500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one-percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten) and, for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the community.

Peak discharges for Waackaack Creek were calculated by the COE during the design of the Raritan Bay and Sandy Hook Bay Beach Erosion and Hurricane Project (Reference 7). Discharges were computed utilizing mass hydrographs, peak flood information, and comparison with two gaged streams, Matawan Creek and Walnut Creek. To obtain peak discharges of the selected recurrence intervals for specific locations on Waackaack Creek in Hazlet, the following discharge-drainage formula was utilized:

$$Q_1/Q_m = (A_1/A_m)^{0.7}$$

where Q_1 is the discharge at a specific location, Q_m is the discharge computed at the mouth of Waackaack Creek by the COE, A_1 is the drainage area at a specific location, and A_m is the drainage area at the mouth. Verification of the computed discharges was performed using procedures outlined in Special Report 38 (Reference 6).

The peak discharges for East Creek, Flat Creek, and Monascunk Creek were determined using the methods outlined in Special Report 38 (Reference 6). These methods were developed as a means to calculate the 10-, 50-, and 100-year peak discharges for ungaged streams in New Jersey as based on various hydrologic parameters. The methods relate streamflow to the parameters of drainage area, main channel slope, percent surface storage area, and an index of man-made impervious cover. The 500-year peak discharge was extrapolated from a plot of the three calculated flows on log-probability paper.

A summary of drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges".

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
WAACKAACK CREEK					
At the downstream corporate limits	7.44	1,200	1,800	2,080	2,800
At State Route 36	6.77	1,125	1,685	1,950	2,620
EAST CREEK					
At State Route 36	2.31	463	771	947	1,385
At Middle Road	1.41	367	608	747	1,090
At State Route 35	0.58	213	351	432	630
FLAT CREEK					
At State Route 36	2.08	644	1,070	1,320	1,823
Upstream of the confluence of Monascunk Creek	0.86	334	559	692	910
Upstream of State Route 35	0.67	198	325	401	575
MONASCUNK CREEK					
At the confluence with Flat Creek	0.96	285	469	577	835
At State Route 35	0.75	255	416	511	730

The determination of coastal inundation caused by the passage of a hurricane storm surge was approached by the joint probability method (Reference 8). The storm populations were described by probability distributions of five parameters which influence surge heights. These parameters included central pressure depression (which measures the intensity of the storm), radius to maximum winds, forward speed of the storm, shoreline crossing point, and crossing angle. These characteristics were described statistically as based on an analysis of observed storms in the vicinity of New Jersey. The storm parameters adopted for New Jersey are shown in Table 2. Several primary sources of data were researched for this information (References 8, 9, 10, 11, and 12).

TABLE 2 - PARAMETER VALUES FOR SURGE EVALUATION, NEW JERSEY

Central Pressure (inches Hg)	27.39	27.68	27.97	28.26	28.55	28.84	29.12	29.4	29.7
Assigned Probability:									
Storms Over Land	0.00	0.00	0.000	0.000	0.000	0.00	0.80	0.125	0.075
Storms Over Sea	0.00	0.02	0.055	0.100	0.145	0.15	0.33	0.125	0.075

Storm Radius [Nautical miles (nm)]		37.5	
Assigned Probability:		1.0	
Forward Speed (Knot)	20	30	40
Assigned Probability:			
Storms Over Land	0.76	0.15	0.09
Storms Over Sea	0.56	0.44	0.00

Direction (degree)	-11		20
Assigned Probability:			
Storms Over Land	0.32		0.68
Storms Over Sea	0.06		0.94

Spatial Occurrence Rate	1.22×10^{-3}	Storms Over Land
Storms/nm. yr.	2.28×10^{-3}	Storms Over Sea

A numerical hydrodynamic model of the region was used to simulate the coastal surge generated by any chosen storm (that is, any combination of the five storm parameters defined previously). Performing such simulations for a large number of storms--each of known total probability--permits one to establish the frequency distribution of surge height as a function of coastal location. These distributions incorporate the large scale surge behavior. The effects of northeasters were taken from the study by Meyers (Reference 8). As the final step in the calculations, the astronomic tide for the region is statistically combined with the computed storm tide to yield recurrence intervals of total water level (Reference 13).

A summary of elevation-frequency relationships for Raritan Bay is shown in Table 3, "Summary of Elevations".

TABLE 3 - SUMMARY OF ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
RARITAN BAY	7.4	10.6	11.8	14.9

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding sources studied in detail were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of these flooding sources.

Cross-section data were obtained from topographic maps at a scale of 1:1,200 with a contour interval of 2 feet (Reference 14). Bridge and culvert information, such as elevation data and structural geometry, and below-water cross sections were obtained by field measurements. Cross sections were located at close intervals upstream and downstream of bridges and culverts in order to compute the significant backwater effects of these structures.

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field inspection of the streams and flood plain areas. The channel "n" values for Waackaack Creek ranged from 0.070 to 0.080, and the overbank "n" values ranged from 0.013 to 0.100. The channel "n" values for East Creek ranged from 0.050 to 0.100, and the overbank "n" values ranged from 0.060 to 0.140. For Flat Creek, the channel "n" values ranged from 0.014 to 0.060, and the overbank "n" values ranged from 0.070 to 0.100. The channel "n" values for Monascunk Creek ranged from 0.013 to 0.070, and the overbank "n" values ranged from 0.060 to 0.100.

Water-surface elevations of floods of the selected recurrence intervals were computed through the use of the COE HEC-2 step-backwater computer program (Reference 15). Starting water-surface elevations for Waackaack Creek were taken from and coordinated with the Flood Insurance Study for the Borough of Keansburg (Reference 16). These elevations are not influenced by tidal effects from Raritan Bay because of protection afforded by the Raritan Bay and Sandy Hook Bay Beach Erosion and

Hurricane Project closure gate located at the mouth of Waackaack Creek in the Borough of Keansburg (Reference 7). Starting water-surface elevations for East Creek and Flat Creek were obtained using the slope/area method. Tidal backwater from Raritan Bay affects the downstream portions of both creeks. Starting water-surface elevations for Monascunk Creek were taken from the flood profiles for Flat Creek.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross-section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 3).

The flooding information for Chingarora Creek was taken from the analyses performed for the Flood Insurance Studies of the Boroughs of Keyport and Union Beach (References 17 and 18).

All elevations used in this study are referenced to the National Geodetic Vertical Datum of 1929 (NGVD), formerly referred to as Sea Level Datum of 1929. Locations of the elevation reference marks used in the study are shown on the maps.

The hydraulic analyses for this study are based on the effects of unobstructed flow. The flood elevations shown on the profiles are valid only if hydraulic structures remain unobstructed and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FEMA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:1,200 with a contour interval of 2 feet (Reference 14). The 100- and 500-year flood boundaries for the areas

affected by tidal flooding from Raritan Bay were delineated using the topographic maps reference above. In cases where the 100- and 500-year flood boundaries are close together, only the 100-year boundary has been shown.

For the streams studied by approximate methods, the boundary of the 100-year flood was delineated using the Flood Hazard Boundary Map for the Township of Hazlet (Reference 19).

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 3). Small areas within the flood boundaries may lie above the flood elevations and, therefore, may not be subject to flooding. Owing to limitations of the map scale and lack of detailed topographic data, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood can be carried without substantial increases in flood heights. Minimum standards of the FEMA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. However, the State of New Jersey has established criteria limiting the increase in flood heights to 0.2 foot. Thus, floodways having no more than a 0.2-foot surcharge have been delineated for this study. The floodways in this report are presented to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plains. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 4).

As shown on the Flood Boundary and Floodway Map (Exhibit 3), the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown. Fluvial flooding can occur on

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Waackaack Creek								
A	7,490[1]	511	2,740	0.7	9.1	9.1	9.3	0.2
B	8,340[1]	683	3,130	0.6	9.1	9.1	9.3	0.2
C	8,790[1]	552	2,622	0.7	9.2	9.2	9.4	0.2
D	9,040[1]	712	3,315	0.6	9.2	9.2	9.4	0.2
E	9,850[1]	458	2,180	0.9	9.2	9.2	9.4	0.2
F	11,025[1]	1,080	3,068	0.6	9.5	9.5	9.7	0.2
G	11,525[1]	1,140	4,263	0.5	9.5	9.5	9.7	0.2
H	12,100[1]	937	3,025	0.6	9.6	9.6	9.8	0.2
I	13,000[1]	240	1,030	1.9	9.8	9.8	10.0	0.2
J	13,275[1]	530	2,234	0.9	10.1	10.1	10.3	0.2
East Creek								
A	4,800[2]	33	232	4.1	16.1	16.1	16.2	0.1
B	5,920[2]	173	633	1.5	17.9	17.9	18.0	0.1
C	6,945[2]	320	890	0.8	23.0	23.0	23.0	0.0
D	7,730[2]	127	332	2.3	25.4	25.4	25.6	0.2
E	8,070[2]	103	269	2.8	26.8	26.8	26.9	0.1

[1]Feet from corporate limits
[2]Feet above corporate limits

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HAZLET, NJ
(MONMOUTH CO.)

FLOODWAY DATA

WAACKAACK CREEK AND EAST CREEK

BEST DOCUMENT AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Flat Creek								
A	1,850[1]	112	579	2.3	11.9	11.9	12.0	0.1
B	2,550[1]	225	909	1.5	12.7	12.7	12.8	0.1
C	3,500[1]	98	351	3.8	15.4	15.4	15.5	0.1
D	4,450[1]	120	170	4.1	23.5	23.5	23.5	0.0
E	4,950[1]	50	218	3.2	26.2	26.2	26.3	0.1
F	5,775[1]	46	185	3.7	27.3	27.3	27.5	0.2
G	6,775[1]	50	134	5.2	30.9	30.9	31.1	0.2
H	7,900[1]	96	441	1.3	40.9	40.9	40.9	0.0
I	8,550[1]	21	47	8.5	41.0	41.0	41.0	0.0
Monascunk Creek								
A	450[2]	61	169	3.4	20.7	20.7	20.8	0.1
B	980[2]	40	164	3.5	25.0	25.0	25.1	0.1
C	1,400[2]	18	132	4.4	27.9	27.9	28.0	0.1
D	1,950[2]	100	144	4.0	30.8	30.8	30.9	0.1
E	2,810[2]	100	243	2.4	34.8	34.8	35.0	0.2
F	4,070[2]	135	520	1.0	43.7	43.7	43.7	0.0
G	5,115[2]	73	245	2.1	44.5	44.5	44.6	0.1

[1]Feet above corporate limits
[2]Feet above confluence with Flat Creek

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HAZLET, NJ

(MONMOUTH CO.)

FLOODWAY DATA

FLAT CREEK AND MONASCUNK CREEK

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Waackaack Creek; however, a floodway was deemed inappropriate from the downstream corporate limits to State Route 36 due to the hydraulic characteristics of the flood plain, i. e., shallow flooding in the overbanks, etc. This determination was made after consultation with the regional office of the FEMA.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 0.2 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

Floodway Schematic - Figure 2

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FEMA has developed a process to transform the data from the engineering study into flood insurance

criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for each flooding source affecting the Township of Hazlet.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of the Township of Hazlet are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 5A).

In areas where a wave height analysis was performed, reaches were determined for areas of the coastline which have the same physical characteristics. The reach determined for the area where a wave height analysis was performed is summarized in Table 5B, "Flood Insurance Zone Data".

TABLE 5B - FLOOD INSURANCE ZONE DATA

Flooding Source	Stillwater Elevation 10-Year	Stillwater Elevation 100-Year	FHF	Zone	Base Flood Elevation (Feet NGVD)*
Raritan Bay Chingarora Creek shoreline from Stone Road to approximately 100 feet upstream of Oak Street	7.4	11.8	055	A11	12

*Due to map scale limitations, base flood elevations shown on the FIRM represent average elevations for the zones depicted.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Waackaack Creek							
Reach 1	02	-1.0	-0.3	+0.5	010	A2	Varies
East Creek							
Reach 1	02	-1.2	-0.4	+0.8	010	A2	Varies
Reach 2	02	-2.2	-0.7	+0.8	020	A4	Varies
Reach 3	02	-1.4	-0.3	+0.7	015	A3	Varies
Flat Creek							
Reach 1	02	-1.4	-0.5	+0.6	015	A3	Varies
Monascunk Creek							
Reach 1	01,02	-2.2	-1.0	+1.7	020	A4	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 5A

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HAZLET, NJ

(MONMOUTH CO.)

FLOOD INSURANCE ZONE DATA

WAACKAACK CREEK, EAST CREEK, FLAT CREEK AND MONASCUNK CREEK

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Raritan Bay (Tidal Flooding Affecting Waackaack Creek, East Creek, Flat Creek, and Chingarora Creek from approximately 100 feet upstream of Oak Street to the upstream corporate limits)	01,02	-4.4	-1.3	+2.9	045	A9	12

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 5A

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HAZLET, NJ

(MONMOUTH CO.)

FLOOD INSURANCE ZONE DATA

RARITAN BAY

BEST DOCUMENT AVAILABLE

The tidal areas where no wave height analysis was performed, reaches are limited to the distance for which the difference between the 10- and 100-year flood elevations does not vary more than 1.0 foot. Using these criteria, the Chingorora Creek shoreline from approximately 100 feet upstream of Oak Street and the tidal portions of Waackaack Creek, East Creek, and Flat Creek qualify as a reach whose flooding source is Raritan Bay. The reach determined for the tidal flooding source in the Township of Hazlet is summarized in Table 5A, "Flood Insurance Zone Data".

5.2 Flood Hazard Factors

The FHF is the FEMA device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the Township of Hazlet was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zones A2, A3, A4, A9, and A11:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHF.
Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also, areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

Tables 5A and 5B, "Flood Insurance Zone Data," summarize the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding sources studied in detail in the Township of Hazlet.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Township of Hazlet is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FEMA.

6.0 OTHER STUDIES

While there are no previous reports specifically pertaining to Hazlet, there are several covering the Raritan Bay coastal region. These studies, which were prepared by the New York District of the COE, are concerned exclusively with tidal flooding (References 3 and 4). The COE report projects the intermediate regional flood value to be 11.3 feet NGVD. This Flood Insurance Study has determined that the 100-year flood elevation is 11.6 feet NGVD. the standard project tidal flood value of 14.8 feet NGVD at Sandy Hook was 0.2 foot greater than the value established for this study. The utilization of a longer period of record for this report and a different method of analysis resulted in the discrepancies between this study and the COE report.

The Flood Insurance Study for the Township of Holmdel has been published (Reference 20). The results of this study are in exact agreement with the results of that study. Flood Insurance Studies for the Boroughs of Keansburg, Keyport, and Union Beach and the Township of Middletown are currently being prepared (References 16, 17, 18, and 21). The results of those studies will be in exact agreement with the results of this study.

This study is authoritative for purposes of the Flood Insurance Program, and the data presented here either supersede or are compatible with previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of the Insurance and Mitigation Division of the Federal Emergency Management Agency, Regional Director, Region II Office, 26 Federal Plaza, Room 19-100, New York, New York 10278.

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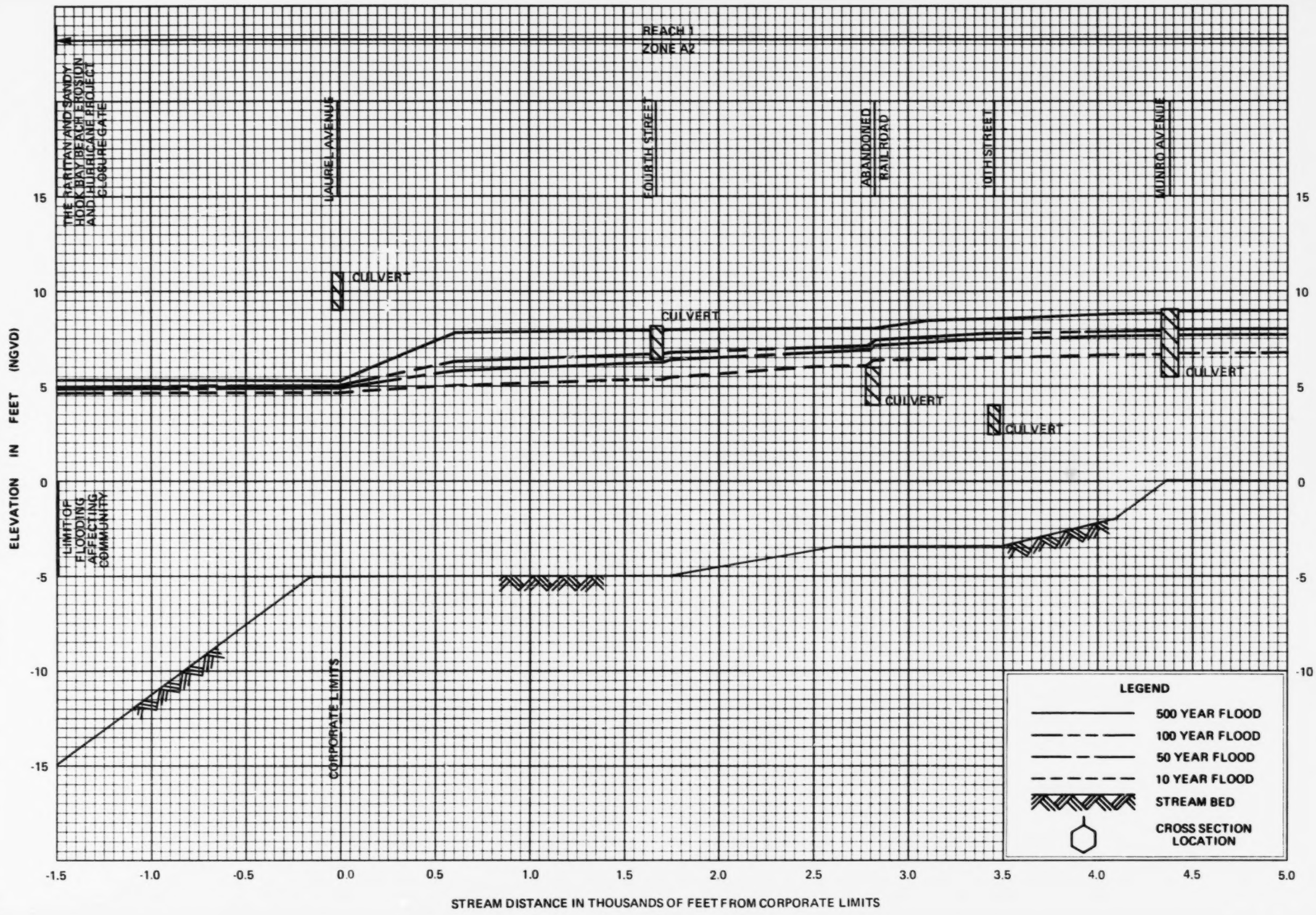

FLOOD PROFILES

WAACKAACK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HAZLET, NJ
(MONMOUTH CO.)

01P

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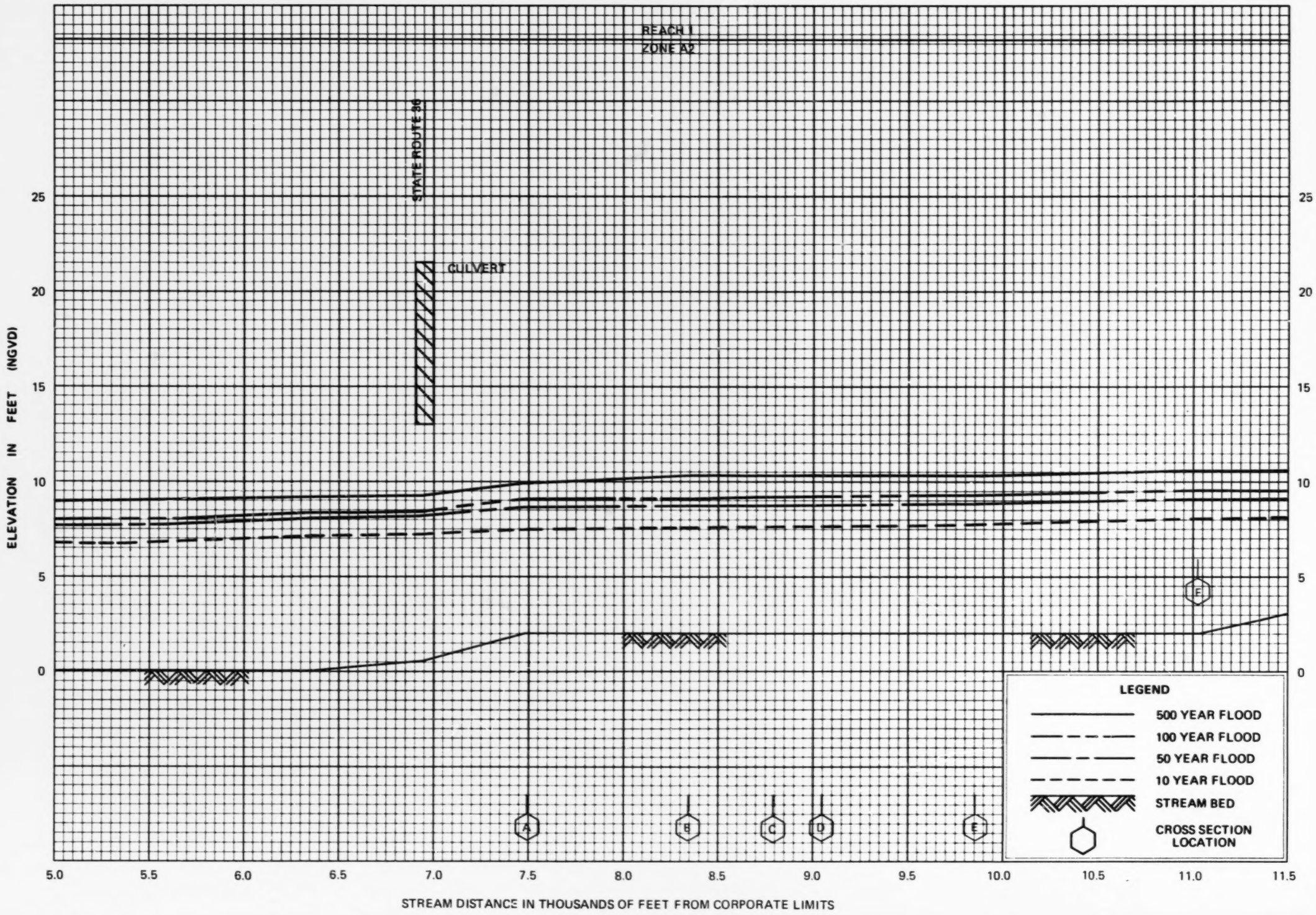

FLOOD PROFILES

WAACKAACK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HAZLET, NJ
(MONMOUTH CO.)

02P

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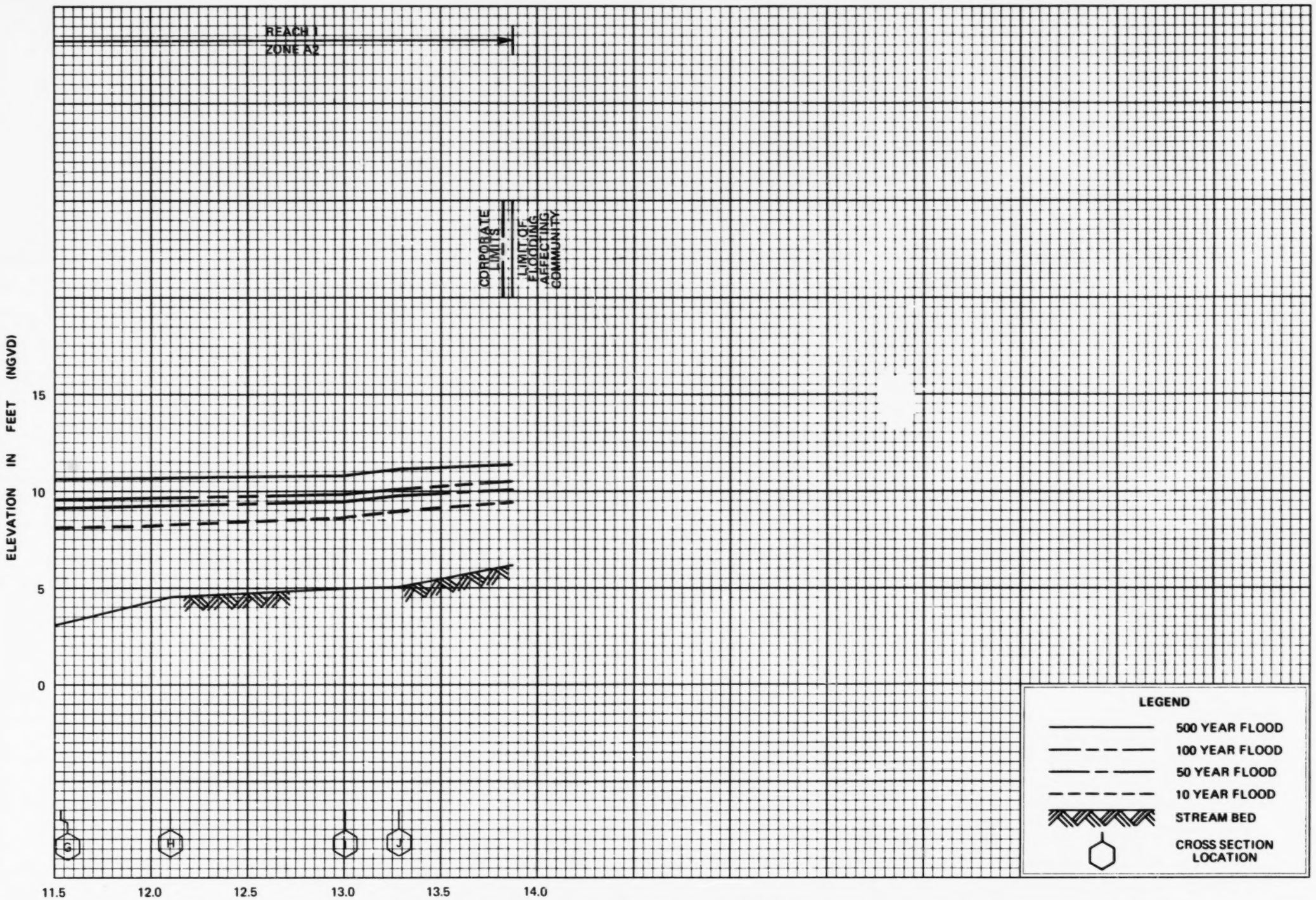

FLOOD PROFILES

WAACKAACK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HAZLET, NJ
(MONMOUTH CO.)

03P

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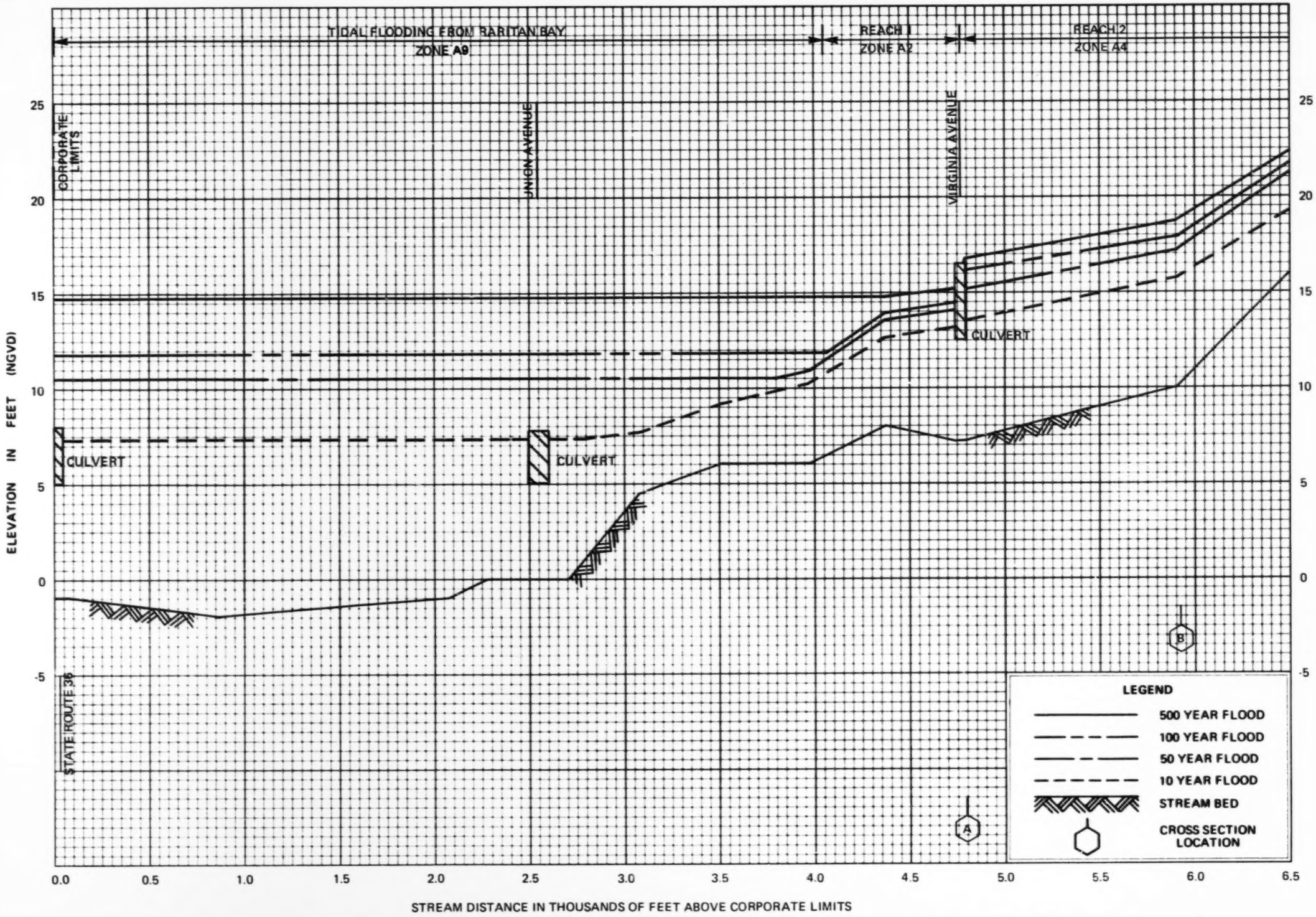

FLOOD PROFILES

EAST CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HAZLET, NJ
(MONMOUTH CO.)

04P

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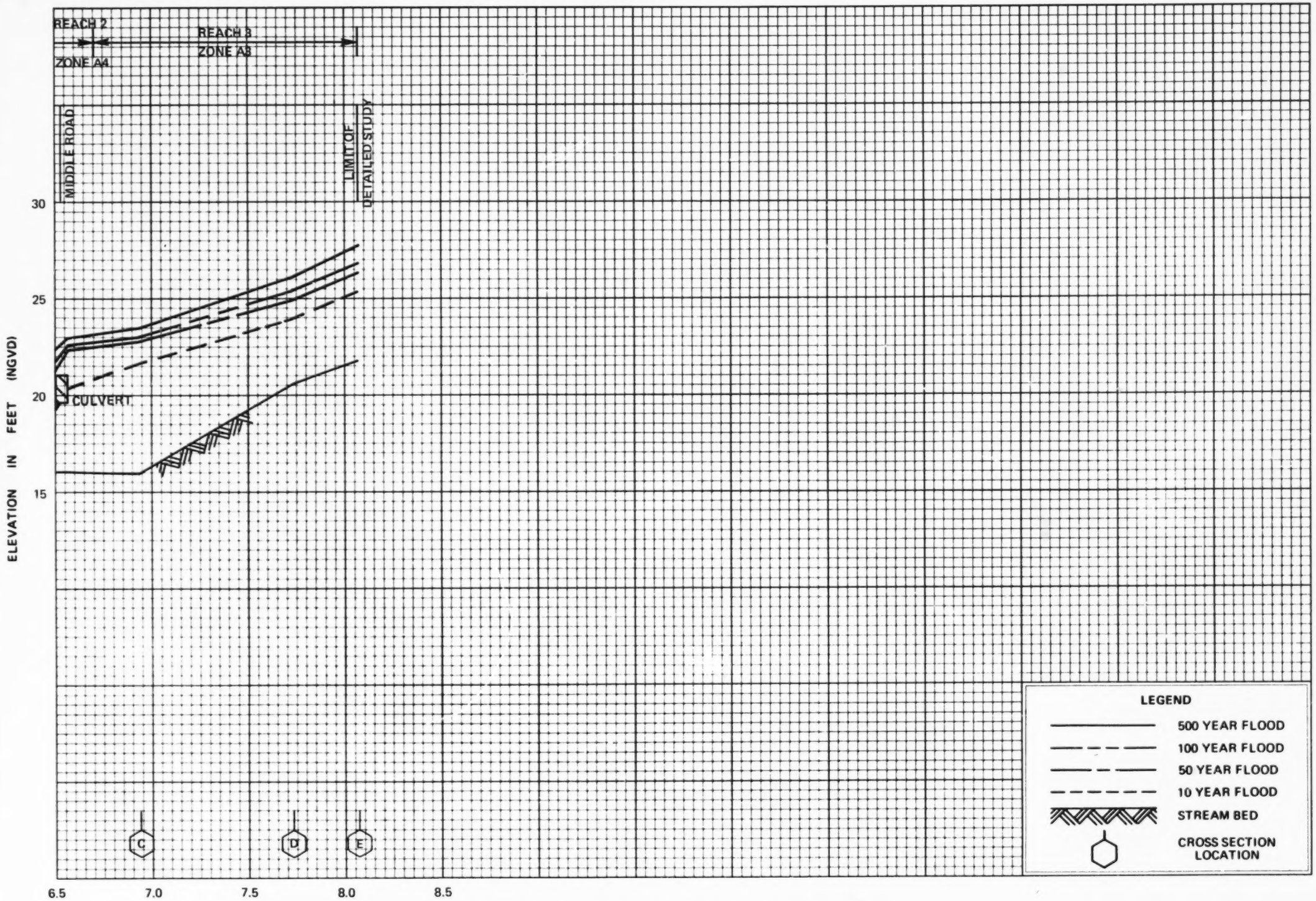

FLOOD PROFILES

EAST CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HAZLET, NJ
(MONMOUTH CO.)

05P

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TIDAL FLOODING FROM RARITAN BAY
ZONE A9

REACH 1
ZONE A3

CORPORATE LIMITS

STATE ROUTE 36

CONFLUENCE OF MONASQUAN CREEK

MIDDLE ROAD

CULVERT

CULVERT

ELEVATION IN FEET (NGVD)

35
30
25
20
15
10
5
0

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5

STREAM DISTANCE IN THOUSANDS OF FEET ABOVE CORPORATE LIMITS

A B C D E F

LEGEND

500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION

FLOOD PROFILES

FLAT CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HAZLET, NJ
(MONMOUTH CO.)

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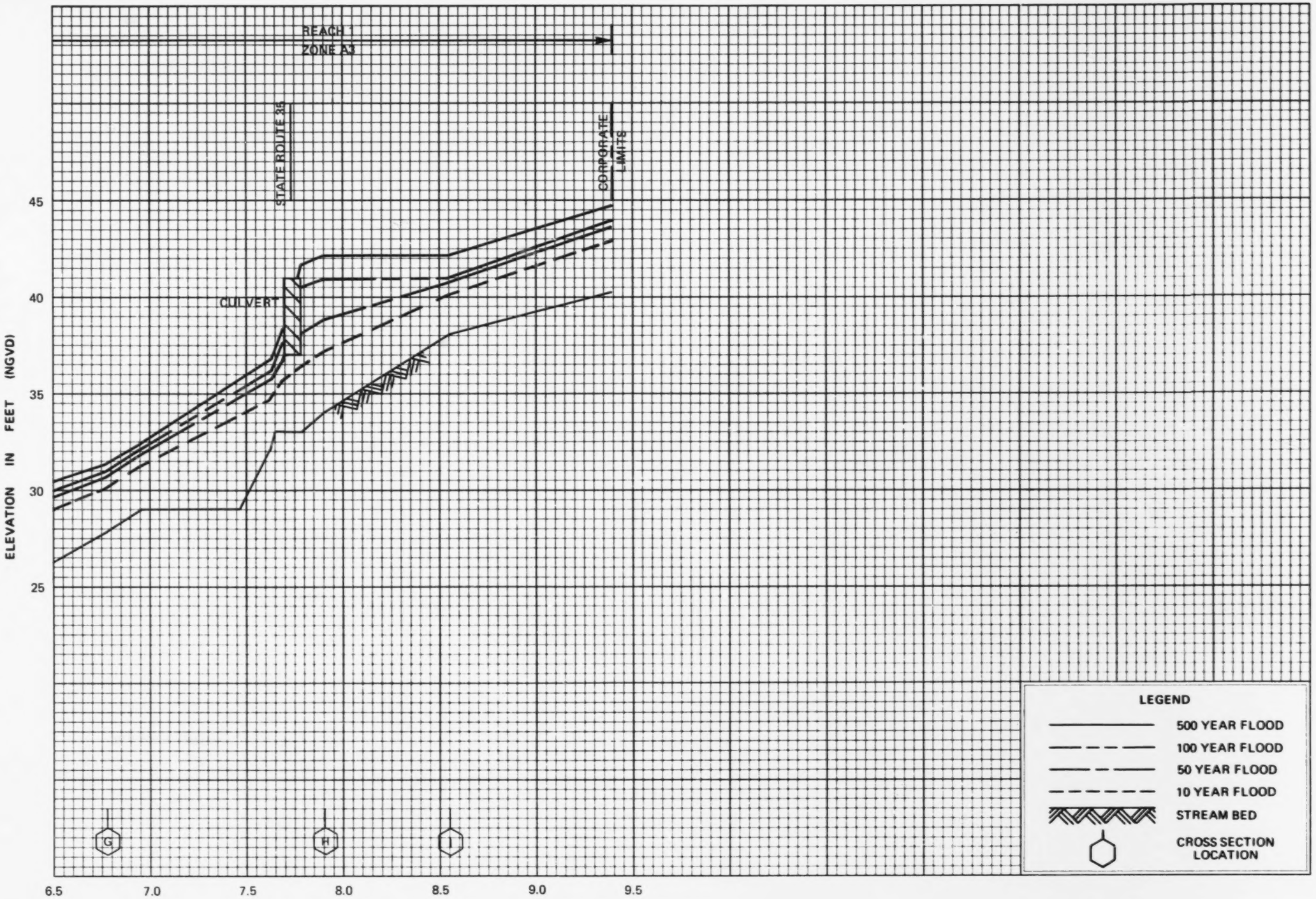

FLOOD PROFILES

FLAT CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HAZLET, NJ
(MONMOUTH CO.)

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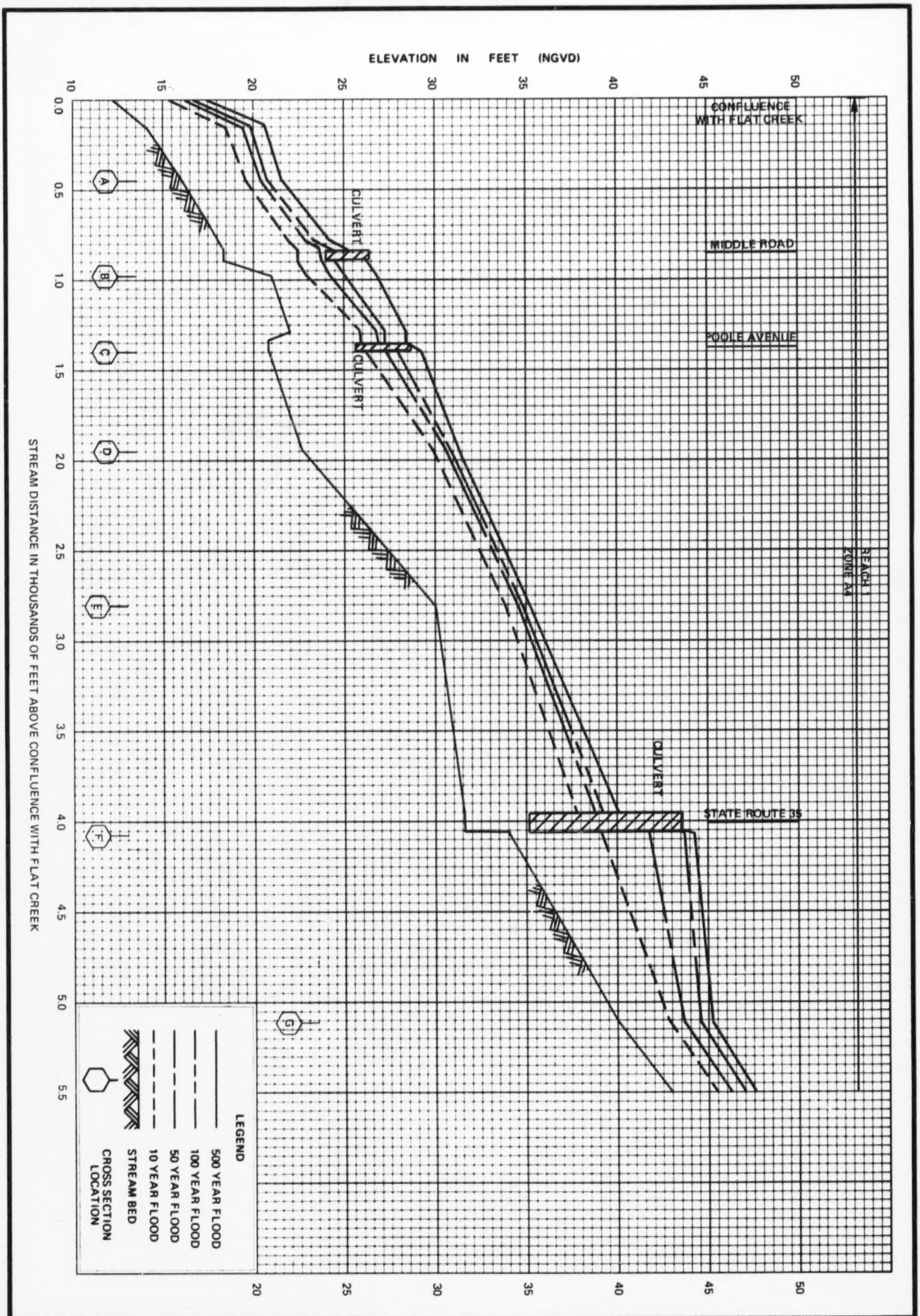

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HAZLET, NJ
(MONMOUTH CO.)

FLOOD PROFILES

MONASCUNK CREEK

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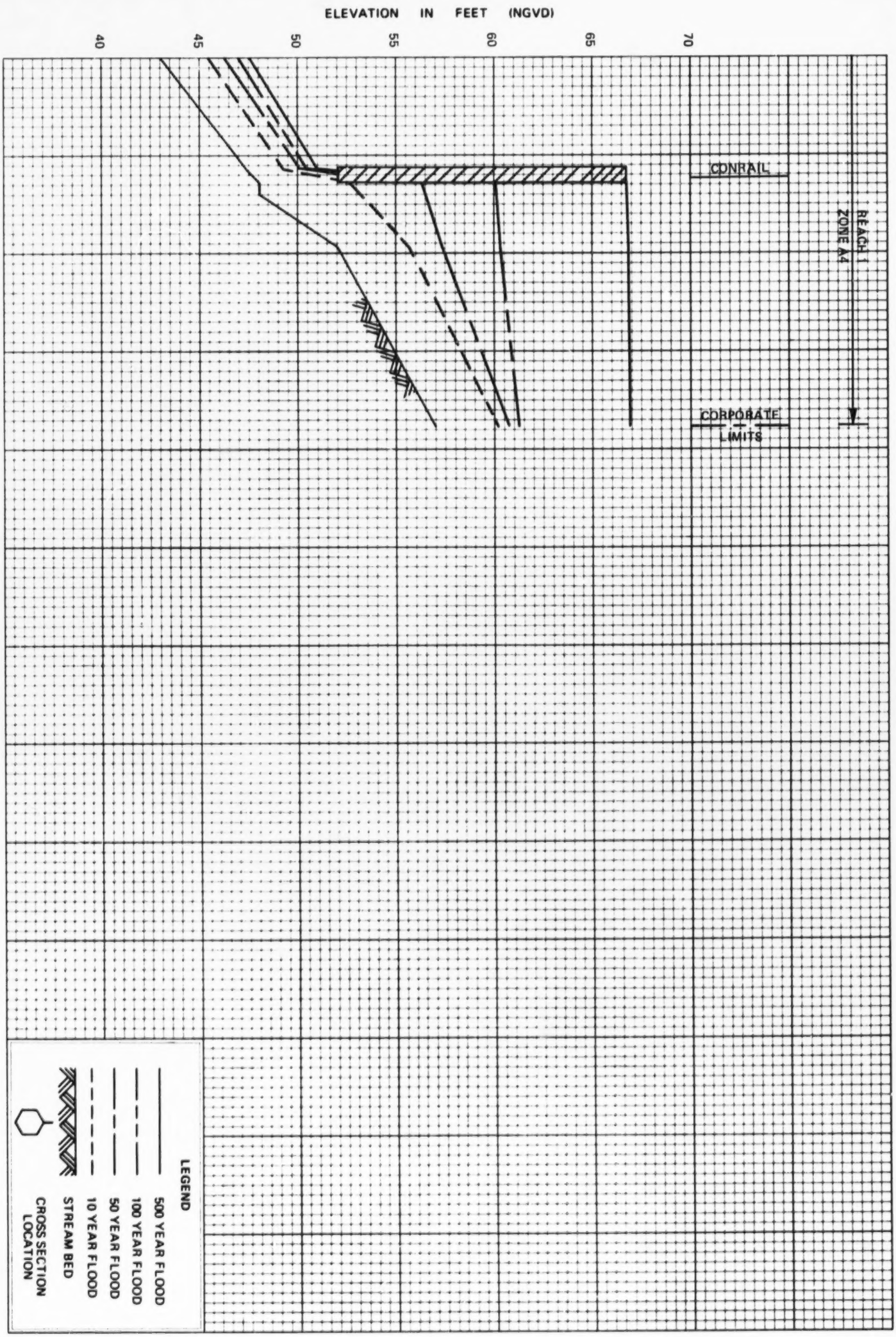

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FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HAZLET, NJ
(MONMOUTH CO.)

FLOOD PROFILES

MONASCUNK CREEK